REMARKS

With this amendment, claims 34, 36, 38-48 are pending.

Restriction Requirement

The claims in this application have been restricted into two groups: Group I (claims 32-33) method of making and Group II (claims 34-48) method of using a microband electrode array sensor. Applicants confirm the election of the claims of Group II. This election is made with traverse. Applicants submit that searching the claims contained in both of these groups would not be an undue burden on the Office.

Amendments to the Claims

Claims 34, 36, and 38 were all amended to add the phrase "wherein the exposed surface of each of said microband electrodes has a width less than about 25 micrometers and a thickness less than about 25 micrometers" after the phrase "Exposed at said single edge". This amendment is fully supported throughout the specification, e.g., at the third full paragraph of page 8.

Claims 34, 36, 38, and 46 have all been amended to delete the phrase "of the kind" to better clarify the claim language.

Claim 36 has been amended to correct informalities noted in the Office Action. The word "step" has been changed to "steps" and the second period has been deleted after the last word in the claim.

Claim 38 has been amended to add the steps "(b) applying an electrical potential to the sensor, and; (c) measuring the electrical current flowing through the sensor." to complete the claim. These amendments correct an inadvertent omission made at the time of filing.

Claims 42 and 43 have been amended to replace the word "from" with "onto". As is described in the specification (e.g., at page 24, lines 27-28 and page 25 lines 4-7), these techniques involve plating by oxidation or reduction of an analyte in solution onto an electrode/surface.

Claim 45 has been amended to delete reference to claim 4 and add the phrase "in the" to correct the grammar of the claim.

New dependent claims 49-68 have been added to more completely describe that which the Applicants consider their invention.

Claims, 49, 54, 59, and 64 specify that the insulating material may be chosen from the group consisting of silicon carbide, silicon nitride, and silicon dioxide. Support for this amendment is found at page 14, last full paragraph.

Claims 50, 55, 60, and 65 specify that the electrode thickness is between about .03 microns to about 5 microns. Support for this amendment is found at page 13 lines 22-25.

Claims 51, 56, 61, and 66 specify that the electrode thickness is between about .1 microns to about .2 microns. Support for this amendment is found at page 16, lines 27-29.

Claims 52, 57, 62, and 67 specify that the microband electrode array sensor further comprises an adhesion layer and that the adhesion layer is chromium. Support for this amendment is found in the paragraph bridging pages 30 and 31.

Objections to the Drawings

In the Office Action, the drawings are objected to. The Office Action states that the single edge provided in claims 46-48 is not shown in the drawings. Applicants submit that Figure 6A does show a single edge formed by the insulating layer 10 and microband electrode 30, and have amended Figure 6 to label this edge 3. No new matter was added by this amendment because the presence of a single edge in the channel embodiment of this invention is fully supported by Figure 6A as drawn and throughout the specification, for example at page 20, lines 16-21, page 19, first full paragraph, and page 9, second and third full paragraphs. Applicants believe that this amendment to the drawings is sufficient to overcome this objection and request that it be withdrawn.

Amendments to the Specification

All amendments to the specification were made to correct typographical errors.

Double Patenting

The Office Action contains numerous rejections under the judicially created doctrine of obviousness-type double patenting, citing U.S. Patent Number 6,110,354. Applicants note that the cited patent is the parent of the present application, and that the claims rejected under the doctrine of double patenting are claims that were subject to a restriction requirement in the parent case. These claims are directed to the non-elected invention in the parent case, that is, they are directed to methods of using a microband electrode array sensor. As such, the rejection of these claims under the doctrine of obviousness-type double patenting is improper. Applicants request that these rejections be withdrawn.

Duplicate Claims under 37 CFR § 1.75

Claim 39 is objected to in the Office Action as allegedly being a substantial duplicate of claim 34. Applicants respectfully traverse this objection. Applicants argue that claims 39 and 34 are not duplicates. Claim 39 is directed to a method of using the described sensor for cyclic voltammetry while claim 34 is directed to a simple scan of potential in one direction. These claims are directed to two distinct methodologies in the electroanalytical arts. Applicants request that this objection be withdrawn.

Claim 40 is objected to in the Office Action as allegedly being a substantial duplicate of claim 36. Applicants respectfully traverse this objection. Applicants argue that claims 36 and 40 are not duplicates because claim 40 is directed to stripping voltammetry, which encompasses both anodic and cathodic stripping voltammetry, while claim 36 is directed to the more specific anodic stripping voltammetry. Because claims 36 and 40 are not duplicate claims, Applicants request that this objection be withdrawn.

Claim 36 was objected to in the Office Action because of the recitation of "step" in line 12 and "voltammetry.." in line 16. Claim 36 was amended to correct these informalities. Applicants request that this objection be withdrawn.

Rejections under 35 USC § 112

Claim 45 was rejected under 35 USC § 112 as allegedly indefinite for citing reference to claim 14. Claim 45 has been amended to delete reference to claim 14 and improve the clarity of the claim.

Claims 34, 36, 38, and 46 were rejected as allegedly indefinite for using the phrase "of the kind". These claims have been amended to remove this phrase.

Claim 38 was rejected as allegedly indefinite for failing to recite a step b. This claim has been amended to add the additional steps "(b) applying an electrical potential to the sensor, and; (c) measuring the electrical current flowing through the sensor."

Applicants believe that amendments made to claims 34, 36, 38, 45, and 46 are sufficient to overcome the rejections made under 35 USC § 112, and request that these rejections be withdrawn.

Rejections under 35 USC § 102

Claims 34, 35, 38, 39 and 41-43 were rejected in the Office Action as allegedly anticipated by Thormann et al. (Anal. Chem. 1985, 57, 2764-2770). Applicants respectfully traverse this rejection.

Claims 34 and 38 are both directed to methods utilizing a microband electrode array sensor comprising a substrate having a first edge; a layer of insulating material, on top of said substrate, said layer of insulating material having a first edge; said first edge of said substrate and said first edge of said insulating material aligned to form a single edge; a plurality of microband electrodes between said substrate and said layer of insulating material, a surface of each of said microband electrodes exposed at said single edge; and a plurality of gaps, one gap between each of two adjacent microband electrodes and each of said gaps having a length great enough that no substantial overlap of diffusion layers occurs. Both claims 34 and 38 have been amended to limit the widths and thicknesses of the microband electrodes to less than 25 μm. Claim 35 has been canceled and claims 39, and 41-43 all depend from either claims 34 or 38.

Applicants argue that Thormann et al. does not anticipate the above-referenced claims for the following reasons. As described in the specification at page 3, lines 24-29, when the individual electrodes are spaced sufficiently far apart, i.e., greater than the diffusion layer, the currents from each individual electrode are additive and non-interfering. If the currents of individual electrodes are not additive, the spacing is not greater than the diffusion layer.

Thormann et al. discloses 7 linear electrode arrays in Table II on page 2766. The electrode widths (which correspond to Applicants width (W) in Fig. 1A of the specification) of the example arrays II to VII in Table II are reported to all be greater than 25 micrometers, i.e., 60, 100, 250 and 500 micrometers. Only array I in Table II has an electrode width reported to be less than about 25 micrometers. The spacing between the electrodes in array I is reported to be 30 micrometers. On page 2767, in column 1, the authors report that the signals of the electrodes of array I when connected in parallel are not additive (Fig. 3). The authors state that these results suggest that there is a small mutual interaction between the electrodes. Array I, therefore, does not have spacings or gaps between the electrodes that are sufficiently large to avoid interference and thus are not greater than the diffusion layer as required in claims 34 and 38.

The linear electrode arrays of Thormann do not combine all the required elements of the sensor of the method claims 34 and 38. Arrays II -VII have electrodes greater than 25 micrometers in width and array I does not have sufficiently large intra electrode gaps that are greater than the diffusion layer.

In view of the forgoing, this rejection should be withdrawn.

Rejections under 35 USC § 103

In the Office Action, claim 34 was rejected as allegedly obvious over Saurer (U.S. 5,407,554) in view of Kuhr et al. (U.S. 5,958,215) and Thormann et al.

Claim 34 is directed to a method of utilizing a microband electrode array sensor (described above) by contacting the sensor with the sample to be analyzed and scanning the voltage from negative to positive in a range to effect oxidation or reduction at the electrodes of the microband array sensor.

The Office Action states:

- that Saurer teaches using a microband sensor comprising the elements of the microband electrode array sensor described in claim 34;
- that while Saurer does not describe using microband electrodes, this is implied in claim 19 and Figures 12 and 14, which discloses that up to 24 narrow electrodes may be on a substrate disc of 5cm diameter;
- that while Saurer does not mention that the gaps between electrodes need be sufficient to prevent overlap of diffusion layers, Thormann et al. does show that if spacing of electrodes is insufficient, inaccuracies in measurement will result and that it would have been obvious to one of ordinary skill in the art at the time the invention was made to have gaps between the electrodes of Saurer large enough to avoid such inaccuracies; and
- that while Saurer as modified by Kuhr et al. does not mention analysis by scanning voltage, Saurer does disclose making measurements with electrodes and Kuhr et al. teaches sinusoidal voltammetry and that it would be obvious to one of ordinary skill in the art at the time the invention was made to use sinusoidal voltammetry with the device of Saurer because sinusoidal voltammetry can be more sensitive for nucleotide or nucleic acid analysis than traditional electrochemical techniques.

Applicants argue that the device, and method of its use, as described in Sauer is different than the device utilized in method claim 34. The device described by Sauer comprises a plurality of sensors (current collectors), each comprising two electrodes (a working electrode and a reference electrode). Each sensor is exposed to the sample to be measured by placing liquid at the measuring zone containing the single sensor, and while exposed, other sensors are isolated and insulated from it (see, for example, Sauer, column 2, lines 42-46). In contrast, the present invention claims a method utilizing a microband electrode *array*, which comprises a plurality of sensing electrodes electrically connected to each other such that their signals are additive. The method of claim 34 comprises contacting sample to the plurality of sensing electrodes that comprises the sensor. Nothing in Saurer teaches or suggests contacting more than one sensing electrode on the multi-sensor disc with a sample to be analyzed. Rather, one measurement zone (one sensing electrode) at a time is used.

Applicants further argue that it would not be obvious to combine the teaching of sufficient gaps between electrodes (Thormann et al.) with the electrode sensor of Saurer because nothing in Saurer teaches or suggests employing multiple sensing electrodes simultaneously. Because the sensing electrodes are not in contact with the sample simultaneously, there would never be any overlap of diffusion layers between electrodes, and therefore no need to provide gaps sufficient to prevent diffusion layer overlap.

Regarding the use of scanning voltammetry with the device of Saurer, Applicants argue that the device of Saurer is taught for use in measuring glucose by current collection between a working electrode and a reference electrode (column 9, lines 45-54). That is, the device of Saurer measures current produced by a reaction between a sample analyte and reactant. Saurer provides neither means nor motivation for *scanning* the voltage between the two electrodes in each measuring zone. Applicants argue that it would not have been obvious to one of ordinary skill in the art at the time the invention was made to scan the voltage using the current collector described by Saurer. Furthermore, even if the sinusoidal voltammetry taught by Kuhr et al. were applied to the device of Saurer et al., the resultant method would still not be the use of a microband electrode array sensor as presently claimed, but the use of a single working and reference electrode system. The combination, therefore, does not teach each and every element of the method of claim 34.

In view of the foregoing, Applicants argue that no *prima facie* case of obviousness has been made, and request that this rejection be withdrawn.

In the Office Action, claims 38 and 41 were rejected as allegedly obvious over Saurer in view of Thormann et al. Claim 41 depends from claim 38. Applicants respectfully traverse this rejection.

Claim 38 describes a method for detecting the presence of and measuring the concentration of analytes in a sample by contacting a microband electrode array sensor with a sample and detecting the analyte in the sample. The microband electrode array sensor comprises, as discussed above, a plurality of microband electrodes exposed at a single edge. The electrodes have gaps between them sufficient to prevent overlap of their diffusion layers. Claim 38 has also been amended to specify that the width and thickness of each electrode is less than 25 microns.

Applicants reiterate the arguments cited above against Saurer. Sauer et al. does not teach a method in which a plurality of microband electrodes contact a sample, but rather teaches the use of a single measurement zone comprising a single sensing electrode and a single reference electrode to make measurements from a sample liquid. Although Thormann et al. does teach the use of microband electrodes, Applicants argue that the combination of the microband electrodes of Thormann et al. with the disc sensor of Saurer does not teach each and every element of the invention of claims 38 and 41 and further argue that the resultant combination would not be meaningful. First, it would not be obvious to combine the teaching of sufficient gaps between electrodes larger than 25 microns (Thormann et al.) with the electrode sensor of Saurer because nothing in Saurer teaches or suggests employing multiple sensing electrodes simultaneously. Because the sensing electrodes are not in contact with the same sample simultaneously, there would never be any overlap of diffusion layers between electrodes, and therefore no need to provide gaps to prevent diffusion layer overlap. Second, if the combination were attempted, it would also not teach or suggest the use of a microband electrode array in which the widths and thickness of the individual microelectrodes are less than 25 microns and in which the gaps between the electrodes are sufficient to prevent diffusion layer overlap.

Because there is no motivation to combine the teachings of Saurer with the teachings of Thormann et al., and even if combined, the resulting method does not teach or suggest each and every element of the invention of claims 38 and 41, Applicants argue that no *prima facie* case of obviousness has been made against claims 38 and 41. This rejection should be withdrawn.

In the Office Action, claim 35 was rejected as allegedly obvious over Saurer in view of Kuhr et al. and Thormann et al. Claim 35 has been canceled, and all of its limitations incorporated into claim 34, as described above. Applicant address the issue of size limitations below.

The Office Action states that although Saurer as modified by Kuhr et al. does not mention that each microband electrode has width and thickness less than 25 microns, Mochizuki et al. show that it was known at the time of the invention how to make electrodes within these dimensions and that it would have been obvious to one of ordinary skill in the art at the time the

invention was made to have electrodes with widths and thickness less than about 25 microns in the invention of Sauer and Kuhr et al. because this would allow the sensor to be small and compact if only small amounts of sample were available.

Arguments against the rejection of claim 34 in view of Saurer, Kuhr et al., and Thormann et al. have been presented above and are referred to in the argument against the present rejection. Applicants argue that Mochizuki's disclosure of a single polarographic electrode having dimension less than 25 microns does not overcome the deficiencies of Saurer, Kuhr et al. and Thormann et al. Thormann et al. also teach the use of electrodes having widths and thicknesses less than 25 microns (Array I), but fails to teach that gaps between such electrodes must be sufficiently large to prevent overlap of the diffusion layers of each electrode. Nothing in Mochizuki in its combination with Saurer, Kuhr et al., and Thormann et al. overcomes this deficiency. Furthermore, the device of Saurer is designed to measure the presence of substances in blood, and is already of sufficient size to measure a single drop of analyte (column 9, lines 45-52). It is not clear, therefore, that there would be any advantage to making the sensing and reference electrodes used in the device of Saurer smaller than 25 microns. Furthermore, because the device of Saurer does not use an *array* of additive electrodes, reducing electrode size may reduce the current produced to immeasurable amounts. Because there would be no advantage in reducing the electrode size in Saurer, Applicants argue that there would be no motivation to do so.

In view of the foregoing, Applicants argue that claim 34, which now has all the limitations of canceled claim 35, is not obvious in over Saurer, in view of Kuhr et al., Thormann et al., and Mochizuki. Applicants request that this rejection be withdrawn.

In separate rejections, claim 34 and claims 38 and 41 were rejected as allegedly obvious over Williams et al. (U.S. 5,460,710) in view of Thormann et al and Kuhr et al., or Williams et al. in view of Thormann et al. Applicants respectfully traverse this rejection.

Claims 34 and 38 are both directed to different methods for utilizing a microband electrode array sensor comprising a substrate having a first edge; a layer of insulating material, on top of said substrate, said layer of insulating material having a first edge; said first edge of said substrate and said first edge of said insulating material aligned to form a single edge; a plurality of microband electrodes between said substrate and said layer of insulating material, a

surface of each of said microband electrodes exposed at said single edge; and a plurality of gaps, one gap between each of two adjacent microband electrodes and each of said gaps having a length great enough that no substantial overlap of diffusion layers occurs. Both of these claims have also been amended to limit the widths and thicknesses of the microband electrodes to less than 25 μm (Claim 34 now has all the limitations of canceled claim 35). Claim 41 depends from claim 38.

The Office Action states that Williams et al. teaches using a microband sensor comprising the elements of the microband electrode array sensor described in claim 34 and 38. In particular, the Office Action states that Williams et al. teaches a plurality of band electrodes (elements 30 and 32 in Figure 4 and elements 50, 54, and 56 in Figure 6) between a substrate and a layer of insulating material such that a surface of each of the electrodes is exposed at a single edge. The Office Action further states that Williams et al. implies that the electrodes used by Williams et al. have widths less than 100 microns. The Office Action also states that while Williams et al. does not mention that the gaps between electrodes should be sufficient to prevent overlap of diffusion layers, this would have been obvious to one of ordinary skill in the art at the time the invention was made in view of the teachings of Thormann et al. to use large enough gaps to prevent inaccuracies in measurement. The Office Action also states that Kuhr et al. teaches sinusoidal voltammetry which would have been obvious to use in the invention of Williams et al. as modified by Thormann et al. to provide more sensitive nucleic acid analysis.

Applicants submit that Williams et al. has been misrepresented in the Office Action as teaching a microband electrode array that is used as in the methods claimed in claims 34 and 38. Also as taught by the Applicants, a microband electrode array is a plurality of identical microelectrodes arrayed such that the individual current signal from each sensing microelectrode is added together to make a large enough signal for accurate measurements to be made. As taught by the Applicants, the spacing of the individual electrodes in an array must be sufficient for the current from each electrode to be non-interfering with the others in the array. In Williams, electrode 39 in Figure 4 is the only working (sensor) electrode in the device. Electrodes 32 and 34 are counter electrodes placed on either side of electrode 30 (column 7, lines 43-46). Also, in Williams, electrodes 50, 54, and 56 (cited above in Figure 6) do not constitute a microband electrode array because they are defined in Williams et al. as a counter electrode, sensing electrode, and independent sensing electrode, respectively (paragraph bridging columns 7 and 8). The independent electrode is useful for verifying test results, or to

serve as means of performing more than one analytical task (column 3, lines 52-58). As such, the signals from these electrodes would not be additive.

Applicants also argue that there would be no motivation to combine the teachings of adequate electrode spacing of Thormann et al. with the device of Williams. First, nothing in Thormann et al. suggests that such spacing would be beneficial between independent sensing electrodes, or between sensing and counter electrodes. Applicants argue that there would not have been motivation to combine the teachings of Thormann as applied to an array of additive sensing electrodes to an array of independent sensing electrodes as taught by Williams. Second, Applicants note that in addition to electrodes 50, 54, and 56 in Williams et al. Figure 6, a fourth electrode, 52, is shown in close proximity to electrode 50 to form an 'interactive' pair of electrodes (column 7, lines 58-60). Williams et al. defines such an 'interactive' pair as one in which the distance between the electrodes is purposely *smaller* than the thickness of the concentration boundary layer, i.e. the diffusion layer (column 4, lines 10-15). Williams, therefore, teaches away from spacing the electrodes at a gap sufficient to prevent the overlap of their diffusion layers.

Because the devices of Williams et al. utilize electrodes that are either single, independent (for separate analytical measurements) or interactive (the gap is not sufficient to prevent overlap of the diffusion layer), the devices used in the methods of Williams et al. are not microband electrode arrays as described in the present specification and claimed in the method claims 34 and 38. Furthermore, Applicants have established, from the teachings of Williams, that there would be no motivation to space the electrodes of Williams et al. farther apart than the thickness of the diffusion layer. In view of the foregoing, Applicants argue that no *prima facie* case of obviousness has been made against claims 34 or claims 38, and 41,and request that these rejections be withdrawn.

In the Office Action, claim 35 was rejected as allegedly obvious over Williams et al. in view of Kuhr et al. and Thormann et al. and further in view of Mochizuki et al. The Office Action states that Williams et al., Kuhr et al., and Thormann et al. are applied in this rejection as applied in a previous rejection of claims 34 and 38. Applicants note that only Williams et al. and Thormann were applied in the rejection of claims 34 and 38, and therefore base their arguments on that application.

Claim 35 has been canceled, and all of its limitations incorporated into claim 34.

Applicants refer to the arguments made above against the rejection of claims 34 and 38, that is that the device described by Williams et al. is not a microband electrode array, but rather an arrangement of either single, independent or interactive electrodes. Applicants argue that the application of Mochizuki et al., in teaching a single electrode, to this combination does not cure the deficiencies outlined above and request that this rejection be withdrawn.

In separate rejections in the Office Action, claims 36, 37, and 40 were rejected as allegedly obvious over 1) Thormann et al. in view of Wojciechowski et al., 2) Williams et al. in view of Thormann et al. and Wojciechowski et al., and 3) Saurer in view of Thormann et al. and Wojciechowski et al. Applicants respectfully traverse this rejection.

Claims 36 and 40 are directed to different methods of using a microband electrode array sensor comprising a substrate having a first edge; a layer of insulating material, on top of said substrate, said layer of insulating material having a first edge; said first edge of said substrate and said first edge of said insulating material aligned to form a single edge; a plurality of microband electrodes between said substrate and said layer of insulating material, a surface of each of said microband electrodes exposed at said single edge; and a plurality of gaps, one gap between each of two adjacent microband electrodes and each of said gaps having a length great enough that no substantial overlap of diffusion layers occurs. Claim 40 is directed to using the array to perform stripping voltammetry while claim 36 is directed toward performing specifically anodic stripping voltammetry. Both of these claims have also been amended to limit the widths and thicknesses of the microband electrodes to less than 25 μm (Claim 36 now has all the limitations of canceled claim 37).

The Office Action states that Thormann et al. teaches using a microband sensor comprising the elements of the microband electrode array sensor described in claims 36 and 40 to perform cyclic voltammetry. The Office Action states that although Thormann et al. does not teach anodic stripping voltammetry, Wojciechowski et al. teaches anodic stripping voltammetry and that it would have been obvious to one of ordinary skill in the art at the time the invention was made to use anodic stripping voltammetry as taught by Wojciechowski et al. in the invention of Thormann et al. because as taught by Wojciechowski et al. the sensor would then be capable of high sensitivity monitoring of metal ions.

Applicants refer to the arguments presented above in the 35 USC 102 rejection of claims 34, 35, 38, 39 and 41-43, and apply them here in arguing that Thormann et al. does not teach or suggest a microband electrode array of the kind claimed for use in the method claims 36 and 40, that is Thormann et al. does not teach an array comprising electrodes that have width and thickness less than 25 microns and that are spaced sufficiently to avoid overlap of their diffusion layers. In Thormann et al. only array I in Table II has an electrode width reported to be less than about 25 micrometers. The spacing between the electrodes in array I is reported to be 30 micrometers. On page 2767, in column 1, the authors report that the signals of the electrodes of array I when connected in parallel are not additive (Fig. 3). The authors state that these results suggest that there is a small mutual interaction between the electrodes. Array I does not have spacings or gaps between the electrodes that are sufficiently large to avoid interference and thus are not greater than the diffusion layer as required in claims 36 and 40. Applicants argue that nothing in Wojciechowski et al., despite teaching the use of anodic stripping voltammetry in a handheld electromonitor device, overcomes the deficiency of Thormann et al. of failing to teach adequate electrode spacing for arrays of electrodes having widths and thickness less than 25 microns, and that the combination of Thormann et al. with Wojciechowski et al. does not teach or suggest every element of claims 36 and 40. Applicants respectfully request that this rejection be withdrawn.

In the rejection of claims 36 and 40 as obvious over Williams et al. in view of Thormann et al. and Wojciechowski et al., Applicants refer to the arguments made above regarding the rejection of claim 34 and claims 38 and 41. Because the electrodes of the devices of Williams et al. are either single sensing electrodes, independent (for separate analytical measurements) or interactive (the gap is not sufficient to prevent overlap of the diffusion layer), the device used in the methods of Williams et al. is not a microband electrode array as described in the present specification and claimed in the method claims 36 and 40. Furthermore, Applicants have established, from the teachings of Williams, that there would be no motivation to space the electrodes of Williams et al. farther apart than the thickness of the diffusion layer, as taught in Thormann et al. Applicants argue that nothing in Wojciechowski et al., despite teaching the use of anodic stripping voltammetry in a handheld electromonitor device overcomes these deficiencies of the combination of Williams et al. with Thormann et al and therefore, the combination of Williams et al. with Thormann et al. and Wojciechowski et al. also does not teach

or suggest every element of claims 36 and 40. Applicants respectfully request that this rejection be withdrawn.

In the rejection of claims 36 and 40 as obvious Saurer in view of Thormann et al. and Wojciechowski et al., Applicants refer to the arguments made above regarding the rejection of claims 38 and 41, in part that the combination of Saurer with Thormann et al. would not be obvious to one of ordinary skill in the art at the time the invention was made because Saurer describes using a device having a single measurement zone comprising a working electrode and a reference electrode and not an array of working electrodes used simultaneously, as taught by Thormann et al. The combination of Saurer with Thormann et al. does not teach or suggest each and every element of claims 38 and 41, and in the same manner does not teach or suggest each and every element of claims 36 and 40. Applicants argue that nothing in Wojciechowski et al., despite teaching the use of anodic stripping voltammetry in a handheld electromonitor device, overcomes the deficiencies of the combination of Saurer with Thormann et al and therefore, the combination of Williams et al. with Thormann et al. and Wojciechowski et al. also does not teach or suggest every element of claims 36 and 40. Applicants respectfully request that this rejection be withdrawn.

In separate rejections in the Office Action, claims 39, 42, and 43 were rejected as allegedly unpatentable over 1) Saurer in view of Thormann et al. as applied to claim 38, and further in view of Kuhr et al; and 2) Williams et al. in view of Thormann et al. as applied to claim 38 and further in view of Kuhr et al.

Claims 39, 42, and 43 are all dependent on claim 38, and are directed to specific electrochemical techniques (cyclic voltammetry and anodic and cathodic stripping voltammetry).

The Office Action states that while Saurer as modified by Kuhr et al. does not mention scanning the voltage as claimed, Kuhr et al. teaches sinusoidal voltammetry and it would have been obvious to one of ordinary skill in the art at the time the invention was made to use sinusoidal voltammetry as taught by Kuhr et al. in the invention of Saurer et al. as modified by Thormann et al. because Kuhr et al. teaches that sinusoidal voltammetry can be more sensitive for nucleotide or nucleic acid analysis than traditional electrochemical techniques.

Applicants refer to their arguments regarding the rejection of claim 38 as obvious over Saurer in view of Thormann et al., reiterating that the combination of Saurer with Thormann would not be obvious to one of ordinary skill in the art at the time the invention was made because Saurer describes using a device having a single measurement zone comprising a single working (sensing) electrode and a reference electrode and not an array of sensing electrodes used simultaneously, as taught by Thormann et al. The combination of Saurer with Thormann et al. does not teach or suggest each and every element of claim 38. Nothing in Kuhr et al. cures the deficiency of this combination, there is no motivation in any of these references to scan the voltage in the current collector taught by Saurer, and therefore the device that is the result of combination with Kuhr et al. also does not teach each and every element of the method of claim 38, from which claims 39, 42 and 43 depend.

Similarly, Applicants refer to their arguments regarding the rejection of claim 38 as obvious over Williams et al. in view of Thormann et al., reiterating that because the electrodes used in the device of Williams et al. are either single, independent (for separate analytical measurements) or interactive (the gap is not sufficient to prevent overlap of the diffusion layer), the device used in the methods of Williams et al. is not a microband electrode array as described in the present specification and claimed in the method claim 38. Furthermore, Applicants have established, from the teachings of Williams, that there would be no motivation to space the electrodes of Williams et al. farther apart than the thickness of the diffusion layer.

As stated in the Office Action Kuhr et al. teaches the use of sinusoidal voltammetry (comprising sine wave excitation) for the electrochemical detection of nucleic acids. Applicants argue that sinusoidal voltammetry is *not* the equivalent of any of the electrochemical methods of claims 39, 42, and 43 - cyclic voltammetry or stripping voltammetry.

Because neither of the combinations of Saurer, Thormann et al., and Kuhr et al., and Williams, Thormann et al. and Kuhr et al teaches or suggests each and every element of claims 39, 42, and 43, Applicants argue that these rejections should be withdrawn.

Information Disclosure Statement

At the Examiner's request, Applicants have provided a copy of the article by Guerin, et al. that was cited in the IDS filed November 24, 2000.

CONCLUSION

All rejections and objections of the claims are believed overcome. Reconsideration and withdrawal of the rejections and objections is respectfully requested. No new matter has been added by any amendment.

With this amendment, this application is believed to be in order for allowance and passage to issuance is respectfully requested. It is believed that no fee is due with the submission of this Amendment. If this is incorrect, however, please charge the required fee and the fee for any extension of time needed to Deposit Account No. 07-1969.

Respectfully submitted,

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34. (Once amended) A method of utilizing a microband electrode array sensor [of the kind] comprising:

a substrate having a first edge;

a layer of insulating material, on top of said substrate, said layer of insulating material having a first edge;

said first edge of said substrate and said first edge of said insulating material aligned to form a single edge;

a plurality of microband electrodes between said substrate and said layer of insulating material, a surface of each of said microband electrodes exposed at said single edge, <u>wherein the exposed surface of each of said microband electrodes has a width less than about 25 micrometers and a thickness less than about 25 micrometers</u>; and

a plurality of gaps, one gap between each of two adjacent microband electrodes and each of said gaps having a length great enough that no substantial overlap of diffusion layers occurs<u>,</u> which method comprises the steps of:

(a) contacting said sensor with a sample suspected of containing an analyte; and

(b) scanning the voltage from a negative voltage to a positive voltage such that the scanned voltage is of a range where said analyte should be oxidized or reduced at said microband electrode.

36. (Once amended) A method of utilizing a microband electrode array sensor [of the kind] comprising a substrate having a first edge;

a layer of insulating material on top of said substrate, said layer of insulating material having a first edge;

said first edge of said substrate and said first edge of said insulating material aligned to form a single edge;

a plurality of microband electrodes between said substrate and said layer of insulating material, a surface of each of said microband electrodes exposed at said single edge <u>wherein the exposed surface of each of said microband electrodes has a width less than about 25 micrometers and a thickness less than about 25 micrometers</u> and;

a plurality of gaps, one gap between each of two adjacent microband electrodes and each of said gaps having a length great enough that no substantial overlap of diffusion layers occurs ;said method comprising the [step] steps of:

(a) contacting said sensor with a sample suspected of containing an analyte; and

(b) performing anodic stripping voltammetry.[.]

38. (Once amended) A method of detecting the presence and measuring the concentration of analytes in a sample, the method comprising the steps of:

(a) contacting a microband electrode array sensor [of the kind] comprising:

a substrate having a first edge;

a layer of insulating material on top of said substrate, said layer of insulating material having a first edge;

said first edge of said substrate and said first edge of said insulating material aligned to form a single edge;

a plurality of microband electrodes between said substrate and said layer of insulating material, a surface of each of said microband electrodes exposed at said single edge, wherein the exposed surface of each of said microband electrodes has a width less than about 25 micrometers and a thickness less than about 25 micrometers; and

a plurality of gaps, one gap between each of two adjacent microband electrodes and each of said gaps having a length great enough that no substantial overlap of diffusion layers occurs;

with a sample suspected of containing an analyte[.];

(b) applying an electrical potential to the sensor, and;

(c) measuring the electrical current flowing through the sensor.

42. (Once amended) The method of claim 38 wherein the analyte is detected by:

(a) applying a positive voltage for a sufficient time to allow for an analyte to be oxidized [from] onto the microband electrode; and

(b) scanning the voltage in a negative direction to reduce the plated analyte off the microband electrode.

43. (Once amended) The method of claim 38 wherein the analyte is detected by:

(a) applying a negative voltage for a sufficient time to allow for an analyte to be reduced [from] onto the microband electrode; and

(b) scanning the voltage in a negative direction to oxidize the plated analyte off the microband electrode.

45. (Once amended) The method of claim 44 wherein in the multi-layer microband electrode sensor [of claim 14 wherein] each of said substrates is planar.

46. (Once amended) A method for performing electrochemical measurements on a sample comprising the step of contacting a sample suspected of containing an analyte with a microband electrode array sensor [of the kind] comprising:

a substrate having a first edge;

a layer of insulating material on top of said substrate, said layer of insulating material having a first edge;

said first edge of said substrate and said first edge of said insulating material aligned to form a single edge;

a plurality of microband electrodes between said substrate and said layer of insulating material, a surface of each of said microband electrodes exposed at said single edge; and

a plurality of gaps, one gap between each of two adjacent microband electrodes and each of said gaps having a length great enough that no substantial overlap of diffusion layers occurs; and

wherein the sensor is integrated into a channel.

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Amendments to the Specification - Version with markings to show changes made.

Page 4, third full paragraph

U.S. Patent No. 5,670,031 by Hintsche et al. describes an electrochemical sensor with multiple interdigital microelectrodes with structure widths [*] in the sub-micron range. The spaces between the interdigitated electrodes is about 700 nm, "which are small relative to the distances traveled by the molecules to be detected, in the measuring time."

Page 30, paragraph heading above first full paragraph

Simultaneous Determination of Cu(II) and Hg(II) at [ ]Microband Electrodes

Page 30, first full paragraph

Due to the high mass transport rate constants associated with microband electrodes, it was decided to test the response of the Pt and Au band arrays in aqueous solutions containing trace amounts of Cu(II) and Hg(II) without any deliberately added supporting electrolyte and without solution deoxygenation. As an indication of the sensitivity of the band electrodes, similar measurements in the same solution were made using microdisk array electrodes as described in U.S. Provisional Application Serial No._60/030,319, which was filed on November 1, 1996. For these measurements, background subtraction was not used so the true nature of the electrode responses could be observed. Figure 17 shows the response of an array of ten 25 μm diameter Au microdisk electrodes. As can be seen from the figure, the maximum sensitivity obtained with a 180 second deposition was 500 ppb. Slightly better results were obtained with an array of six 25 μm diameter Pt microdisk electrodes. The maximum sensitivity for the Pt array was 250 ppb with a 180 second deposition time and is illustrated in Figure 18. The same sensitivity was also obtained with an array of ten 7 μm diameter carbon microdisk electrodes. As illustrated in Figure 19, the maximum response for the carbon array was also 250 ppb for a 180 second deposition time.